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END OF SEARCH HISTORY

L17: Entry 1 of 6 File: USPT Jun 13, 2006

DOCUMENT-IDENTIFIER: US 7061936 B2
TITLE: Method and apparatus for packet transmission with header compression

PRIOR-PUBLICATION:

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Abstract Text (1):
Under the situation in a network including a transmitter and a receiver in which a transmitter converts a non-compressed packet to be transmitted as a full-header packet including a full header or a header-compressed packet including a compressed header, and sends the converted packet to the receiver, the transmitter sends at least an important packet in the non-compressed packet to be transmitted as a full-header packet. The important packet means for example, a packet containing the data serving an important role when the data terminal eventually receiving each packet reproduces the audio and/or image in accordance with the data in each packet.

Brief Summary Text (7):
FIG. 13A shows contents of an RTP header, UDP header, and IP header (hereafter, referred to as "RTP/UDP/IP headers") attached to data, such as audio and video data, to be transmitted according to the RTP, UDP and IP. Hereinafter, a packet including the RTP/UDP/IP headers is called an IP packet.

Brief Summary Text (8):
As shown in the drawing, the IP header needs 20 bytes, the UDP header needs 8 bytes, and the RTP header needs 12 bytes, thus the total amount of RTP/UDP/IP headers reaches 40 bytes. In contrast, video data contained in one IP packet comprises, for example, about 50 bytes. For transmitting such image data in the form of packets, the overhead reaches therefore no less than 44 percent. Similarly, for transmitting audio data which comprises 20 bytes in one packet, the overhead reaches as much as 66 percent. Since a practical transmission needs headers for other layers to be added, the whole headers occupy a large percentage of one packet, thereby causing a drawback of reducing efficiency in communication.

Brief Summary Text (9):
As one technique to overcome the drawback, the RFC2508 issued by the IETF shows an RTP compression protocol to compress the RTP/UDP/IP headers. The RTP compression protocol permits the RTP/UDP/IP headers shown in the FIG. 13A to be compressed into a header exemplified in FIG. 13B (hereinafter referred to as a "compressed header"). This compression will be detailed as follows.

Brief Summary Text (10):
The method of the compression is applied between two nodes on a network through which packets are transmitted among a plurality of data terminals, for example. More specifically, of the two nodes, one node (hereinafter referred to as a "sender node") converts the RTP/UDP/IP headers of one part of the IP packets communicated among the data terminals into a compressed header, and transmits it, as a header-compressed packet, to the other node (hereinafter referred to as a "receiver node"). Concurrently, the sender node transmits the RTP/UDP/IP headers of the other

part of the IP packets to the receiver node, as a full-header packet without any compression. The receiver node decompresses (i.e., restoration) to an IP packet the header-compressed packet or the full-header packet received from the sender node, and sends it to the next node or a receiver data terminal. The full header is a header in which lengths included in the RTP/UDP/IP headers shown in FIG. 13A are replaced by information including a CONTEXT_ID for identifying the RTP connection and a link sequence number link seq, a serial number, given in the order of transmission from the sender node.

Brief Summary Text (11):
The content of the compressed header shown in FIG. 13B will now be explained. The data of sections with dense hatching applied in the RTP/UDP/IP headers in FIG. 13A, which includes a version number (V) written in the IP header and the payload type written in the RTP header, are constant data (hereinafter referred to as "static fields") for each packet to be transmitted from the sender node. Hence, as illustrated in FIG. 13B, the compressed header does not include data of the static fields. When the sender node sends the first IP packet of the packet stream to the receiver node, it sends a full-header packet which has a full header including the static fields. After this, the sender node converts the RTP/UDP/IP headers of the succeeding IP packets into a compressed header with no static fields included. The thus-converted compressed header is sent to the receiver node as a header-compressed packet. When the receiver node receives the full header packet corresponding to the first IP packet, the receiver node restores the received RTP/UDP/IP headers with reference to the full header in the first received full-header packet, and writes the thus decompressed headers into an internal storage device. After this, the receiver node uses the static fields of the RTP/UDP/IP headers so as to restore the static fields of the compressed header in the header-compressed packets that will be received successively after the first packet.

Brief Summary Text (12):
The data in the static fields are not always constant over all the IP packets, but might be changed depending on a certain IP packet. If such a change occurs in a certain IP packet, the sender node will transmit a full header packet including a full header corresponding to the RTP/UDP/IP header of the IP packet to the receiver node, without compression.

Brief Summary Text (13):
The data in the sections with no hatching applied in the RTP/UDP/IP headers shown in FIG. 13A include the sequence number and timestamp of the RTP header as well as the ID of the IP header. The timestamp indicates the time at which a packet is transmitted or generated. Such data are expected to have constant difference values (changed amounts) between successive two IP packets transmitted in turn. Hereinafter, fields providing such data are referred to as "delta fields." As shown in FIG. 13B, the basic compressed header does not include the data in the delta fields. As described above, the receiver node, ~~which holds RTP/UDP/IP headers in~~ its storage device, adds difference values, which have been previously obtained, respectively to the values in the corresponding delta fields of the stored RTP/UDP/IP headers, thus being able to decompress delta fields of compressed headers which will consecutively be received thereafter.

Brief Summary Text (14):
However, it is not always true that the difference values in the delta fields are constant between all the IP packets. There are some cases where changes are made to their difference values. In such cases, changed difference values have to be notified to the receiver node. The receiver node is able to restore the contents in the delta fields contained in the RTP/UDP/IP headers of each header-compressed packet which will be received thereafter, with reference to the contents of the RTP/UDP/IP headers held in the storage device and the newly notified difference values. For this purpose, the compressed header shown in FIG. 13A has flags S, T and I that represent whether the difference values in the delta fields are changed

or not. If any difference values are changed, the new difference values are added to the compressed header, as shown by the dotted lines in FIG. 13B. Practically, if there is a change in the difference value of the sequence number of the RTP header, "1" is set to the flag S and a sequence number difference value (delta RTP sequence) showing the new difference value of the sequence number is added to the compressed header, as shown by the dotted line in FIG. 13B. Similarly, if there is a change in the difference value of the timestamp of the RTP header, "1" is set to the flag T, and a timestamp difference value (delta RTP timestamp) showing the new difference value of the timestamp is included in the compressed header, as shown by the dotted line in FIG. 13B. Further, if there is a change in the difference value of the ID of the IP header, "1" is set to the flag I, and an ID difference value (delta IP ID) showing the new difference value of the ID is attached to the compressed header.

Brief Summary Text (15):
As shown in FIG. 13B, the compressed header further includes the CONTEXT_ID and link_seq, like the full header. The receiver node decompresses the compressed header in compliance with the contents of RTP/UDP/IP headers specified by the CONTEXT_ID. The receiver node refers to the link sequence number link_seq of each packet (header-compressed packet or full-header packet) sent in order from the sender node. When it is found that some link sequence numbers are dropped, the receiver node determines that the packets are lost between the transmitter and receiver nodes.

Brief Summary Text (16):
Referring to FIG. 14, procedures made for packet transmission between the transmitter and receiver nodes will now be described. In FIG. 14, a field A shows a static field of the RTP/UDP/IP headers (i.e., any of the data with the dense hatching applied in FIG. 13A), and a field B shows a delta field (i.e., any of the data with no hatching applied in FIG. 13A). Further, in FIG. 14, "F" represents a full-header packet, while "C" represents a header-compressed packet.

Brief Summary Text (18):
The sender node then converts the RTP/UDP/IP headers in an IP packet b received after the IP packet a into a compressed header, and transmits the packet b with the compressed header to the receiver node (refer to "OP2" in FIG. 14). In the compressed header in the header-compressed packet, a difference value .DELTA.B(=1) between a value [1] in the delta fields B of the packet b and a value [0] in the delta fields B of the last packet a is added, while a value of "1" is set to the flags (flags S, T and I shown in FIG. 13B) that represent changes or non-changes in the difference value.

Brief Summary Text (19):
The receiver node, which received the header-compressed packet b, obtains the delta fields B of the compressed headers of the header-compressed packet b by adding the difference value .DELTA.B notified in this packet to the values of the delta fields B of the RTP/UDP/IP headers of the last IP packet a stored in the internal storage. The receiver node then transmits an IP packet b having both of the RTP/UDP/IP headers, which include the delta fields B and the static fields A of the RTP/UDP/IP headers of the IP packet a, and the RTP payload. The RTP/UDP/IP headers referred in decompressing the IP packet b (in this case, the RTP/UDP/IP headers extracted from the last IP packet a) is specified by the CONTEXT_ID of the header-compressed packet b. The RTP/UDP/IP headers of the IP packet b and the difference value .DELTA.B notified in this packet are also stored in the internal storage.

Brief Summary Text (20):
When next receiving an IP packet c, the sender node calculates a difference value between values of delta fields B of both of the IP packet c and the last IP packet b. The difference value .DELTA.B is [1] (=3-2) in this case, which is the same as the previous one notified to the receiver node last time. Therefore, there is no

need to newly notify the receiver node of the unchanged difference value. Hence, the sender node transmits to the receiver node a header-compressed packet c having a compressed header with no difference value (i.e., information shown by the dotted line in FIG. 13B (refer to "OP3" in FIG. 14). The receiver node that received this header-compressed packet c adds the stored difference value .DELTA.B to the delta fields B of the previous packet b, thereby decompressing the delta fields B of this compressed header of the header-compressed packet. Then the receiver node sends an IP packet c composed of both RTP/UDP/IP headers, including the decompressed value and the static fields A extracted from the full header of the full-header packet a, and RTP payload. The next packet d is processed similarly.

Brief Summary Text (21):
The delta fields B of an IP packet e next received by the sender node is [5] in value, of which difference value from the delta fields B of the last IP packet d is [2]. When the difference value .DELTA.B is changed in this way, the sender node transmits a header-compressed packet e having a compressed header in which the changed new difference value is added and the corresponding flag is set to [1]. The receiver node adds the newly notified difference value to the values of the delta fields B of the IP packet d so as to decompress the delta fields B of the packet e, then transmits an IP packet containing the decompressed delta fields B.

Brief Summary Text (22):
The sender node then receives an IP packet g, which is different in the static field A from the last IP packet e. Thus, in this case, the sender node does not compress the RTP/UDP/IP headers of this IP packet and transmits a full-header packet g having a full header in which the lengths in the RTP/UDP/IP headers of the packet g is replaced by the CONTEXT_ID and link_seq. The receiver node that received this full-header packet g converts the full header into the RTP/UDP/IP headers and memorizes them in the internal storage.

Brief Summary Text (23):
The header compression method ruled by the RFC2508 has been described above (hereinafter referred to as a "method A"). However, this compression method has been suffering from some drawbacks, which will be described as follows.

Brief Summary Text (24):
For instance, as shown in FIG. 15, an assumption is made that the header-compressed packet c is lost between the transmitter and receiver nodes for some reason. As described above, when decompressing the packet d, the receiver node adds the difference value .DELTA.B to the delta fields B of the IP packet c to decompress the delta fields B of the IP packet d. As a result, when the header-compressed packet c is lost, it is impossible to decompress the delta fields B of the header-compressed packet d. The receiver node is therefore forced to discard packets d, e and f shown in FIG. 15, which are received until the next full-header packet g. In other words, the loss of the packets causes consecutive losses of some other packets, which leads to reducing a throughput compared to a method in which the header compression is not involved. In particular, in cases the transmitter and receiver nodes are connected by a wireless link, a packet is likely to be lost in the wireless link. If such a loss occurs, some other packets are frequently discarded at the receiver node. As a technique to resolve such a problem, the RFC 2507 and 2508 issued by the IETF and the Internet-Draft provide the following methods.

Brief Summary Text (26):
In the case of the foregoing conventional method A, the sender node transmits a full-header packet only when the static fields of a header change in value. In contrast, as shown in FIG. 16, this method 1 selects several IP packets to be transmitted every predetermined number of packets, regardless of whether the static fields changes in value or not. And the selected IP packets are converted to the full header packets with full headers and the full header packets are transmitted

to the receiver node, while the remaining IP packets are converted to header-compressed packet with compressed headers and the header-compressed packets are transmitted to the receiver node. In the method A, since full-header packets are not transmitted to the receiver node as long as their static fields do not change in value, all the packets transmitted after the occurrence of loss of a packet are discarded. In contrast, the present method 1 allows a full-header packet to be transmitted at intervals, so that it has the advantage that the number of packets discarded owing to the loss of the packets can be lowered. However, the present method 1 has trade-offs that a longer period for transmitting full-header packets results in that the number of packets discarded is raised, whilst a shorter period for transmitting full-header packets results in that a large number of full-header packets with large overheads are transmitted, reducing efficiency in communication.

Brief Summary Text (30):
According to the present method 3, the compressed headers of header-compressed packets received after the loss of a certain packet are decompressed using the RTP/UDP/IP headers decompressed most lately before the occurrence of loss of the packet. For example, as shown in FIG. 18, it is assumed that after a packet b is received in order, a packet c is lost, and then a packet d is received in order. In this situation, when a difference value .DELTA.B is unchanged in value over the packets b to d, the delta fields B of the packet d can be calculated by adding a value of double .DELTA.B to the delta fields B of the packet b. Moreover, the present method needs the UDP checksum included in a compressed header (refer to FIG. 13B), so that the UDP checksum is used to determine if packets were decompressed correctly. However, as shown in FIG. 18, in cases where a packet k is lost and difference values .DELTA.B of the delta fields between packets and k change, there is the problem that a packet 1 received immediately after the packet loss cannot be decompressed correctly. In particular, in the case that packets are communicated via a wireless link, there is a possibility that packets are lost in sequence (namely, over a long interval). Under such a situation, it is considered that difference values .DELTA.B are likely to change for a large number of lost packets. Therefore the foregoing problem is amplified.

Brief Summary Text (32):
According to the present method 4, the difference value .DELTA.B can be estimated on a characteristic of a media through which packets are transmitted. For example, in the case of FIG. 19, it is assumed that packets g and b are lost and difference values .DELTA.B between the packets g and h change. In this case, changes in the difference values .DELTA.B are estimated on a characteristic of a media through which packets are transmitted, and a packet can be decompressed through addition of the estimated difference value .DELTA.B to the packet f. Additionally, the present method uses an error detecting code (CRC) to confirm if the decompression is performed correctly or not. Thus, even if the difference value .DELTA.B changes, the present method enables packets received after the loss of a certain packet to be decompressed. However, the present method involves a difficulty in how the difference value .DELTA.B is estimated.

Brief Summary Text (33):
As described above, although a variety of techniques have been proposed to efficiently perform data communication even when RTP/UDP/IP headers of IP packets are compressed, any technique has some drawbacks. Thus, it is a present situation that there is a limitation in effectively reducing the number of packets to be discarded owing to the loss of a certain packet that has been caused between the transmitter and receiver nodes. That is to say, loss of a part of packets during the packet transmission between the transmitter and the receiver nodes causes loss of the other packets in the receiver node. This causes great damage on the data processing using the packets received by the receiver data terminal (for example, display of image or replay of music using the received packets).

Brief Summary Text (35):
The present invention has been made in view of the foregoing circumstances. An object of the present invention is to provide a packet transmitting method, a relaying device and a data terminal capable of effectively reducing the number of packets to be discarded due to the loss of a certain packet, even if headers of packets to be transmitted and received are compressed.

Brief Summary Text (36):
According to one aspect of the present invention, an object of the present invention is achieved by a packet transmitting method for transmitting packets from a sender node to a receiver node through a network, comprising the steps of conversion by a communication apparatus provided on the sender node, for converting non-compressed packets to be transmitted into either a refresh-header packet with a refresh header containing information enough to be decompressed correctly and recover synchronization at the receiver node or a header-compressed packet with a compressed header containing less information than the refresh header, so that some of the non-compressed packets are converted into the refresh header packets as long as the packets are important packets; and transmission of a packet stream containing the refresh-header packet and the header-compressed packet to the receiver node.

Brief Summary Text (38):
The refresh header can be a full header including the content of the original header of the non-compressed packet. The refresh header also may be another format. For example, in the situation in which the first packet transmitted to the receiver node has initialized the compression state, the sender node may transmit a refresh header which is able to refresh the compression state based on the result of the previous initialization.

Description Paragraph (6):
FIG. 5 is a format of the header of the Compressed non-TCP packet transmitted in the second embodiment of the present invention.

Description Paragraph (10):
FIG. 7 shows a state of transition in the header compression process and reconstruction process by means of ROHC.

Description Paragraph (18):
FIG. 12 shows a format of the IPv6 header used in the variation example of each of the embodiments.

Description Paragraph (20):
FIG. 13B shows a content of the compressed header.

Description Paragraph (28):
With reference to the accompanying drawings, embodiments of the present invention will now be described. The embodiments, which represent various modes of the present invention, do not mean to limit the scope of the present invention and can be modified within the scopes of the present invention.

Description Paragraph (31):
FIG. 1 is a block diagram pictorially exemplifying a configuration of a communication system into which a packet transmitting method of the present invention can be applied. In the communication system, a transmitter data terminal 1 and a receiver data terminal 2 are provided so as to exchange packets through a network 3. The present invention is described hereinafter with reference to an example in which the transmitter terminal 1 sends packets to the receiver terminal 2.

Description Paragraph (33):

In this configuration, the transmitter data terminal 1 sends in sequence packets destined for the receiver data terminal 2 through the network 3. A packet to be sent from the transmitter data terminal 1 is an IP packet including RTP/UDP/IP headers shown in FIG. 13A. The relay apparatus on the sender node 3a receives in order IP packets sent from the transmitter data terminal 1, converts the received IP packets into either full-header packets including a full header or header-compressed packets including a compressed header, and sends them to the receiver node 3b. As described before, the full header is a header in which a length value contained in an IP header or UDP header of RTP/UDP/IP headers of an IP packet is replaced by data including a CONTEXT_ID or link_seq. On the other hand, when receiving the header-compressed packet or full-header packet transmitted from the sender node 3a, the relay apparatus on the receiver node 3b restores the RTP/UDP/IP headers from the compressed-header of the header-compressed packet or the full header of the full-header packet, and sends an IP packet including the RTP/UDP/IP headers to the receiver data terminal 2. The receiver data terminal 2 receives an IP packet sent from the receiver node 3b and performs predetermined processing (for example, display of images, replay of sound, or the like in accordance with an RTP payload) according to the received IP packet.

Description Paragraph (34):
Like the conventional technique described before, the full header packet means a packet enabling to restore an IP packet including RTP/UDP/IP headers on the basis of only contents of the full header included in the full-header packet. The length values included in the RTP/UDP/IP headers are replaced by a CONTEXT_STATE and link_seq, however, the length values can be restored with reference to the information on lower layers as well. In contrast, the header-compressed packet means a packet that can be decompressed to an IP packet based on other packets (such as full-header packet), and cannot be decompressed to an IP packet including RTP/UDP/IP headers based only on the compressed header included in the header-compressed packet.

Description Paragraph (37):
A control portion 33a is a means or unit for controlling each of the receiving portion 31a, the transmitting portion 32a and the storage portion 34a. Practically, the control portion 33a implements the following processes described in item a and b.

Description Paragraph (39):
The relay apparatus provided on the sender node in the related art described above was configured so that the relay apparatus converted the packet with the static field in the header changed, the packet selected every specific fixed numbers, or the packet to be transmitted immediately after receiving CONTEXT_STATE from the receiver node, into a full-header packet without compressing the header of the packet and transmitted the full-header packet to the receiver node. On the contrary, the relay apparatus provided on the sender node 3a of the present embodiment is configured so that the relay apparatus receives IP packets sent from the transmitter data terminal 1, and converts the IP packets whose data is important (hereinafter referred to as an "important packet") into a full-header packet without compressing the header, and transmits the full-header packet to the receiver node 3b. Here, the important packet means the packet including the data which serves important role when the receiver data terminal 2 replays the audio or displays images. More specifically, the important packet means the packet including the data remarkably affecting the quality of the audio or image (for example, deteriorating the quality of the image displayed or music replayed) at the receiver data terminal 2 when the packet is lost. The control portion 33a at the sender node 3a decides that the received IP packet is important in the following cases described hereunder.

Description Paragraph (40):
{circle around (1)} IP Packet with the Marker Bit M in the RTP Header Set or the

Next Packet to the IP Packet with a Marker Bit M Set

Description Paragraph (41):
The marker bit M is contained in the RTP header in the IP packet transmitted from the transmitter date terminal 1. The control portion 33a in the sender node 3a decides importance of the IP packet by examining the marker bit. The detail thereof is described hereunder.

Description Paragraph (42):
In the case where the data transmitted from the transmitter data terminal 1 is video data including several frames, the first data of each frame usually contains very useful information for displaying the images. On the other hand, the marker bit M in the RTP header is generally set in the packet containing the last data of a video frame. The next packet of the packet with the marker bit M in the RTP header set is usually the first data of a video frame. Accordingly, the control portion 33a in the sender node 3a is configured so that the next packet of the packet with the marker bit M in the RTP header set is decided to be the important packet.

Description Paragraph (43):
In addition, there are cases in which the marker bit M in the RTP header may be set when the payload contains some configuration information, e.g., the data structure or the like. On the other hand, the packet containing the configuration information serves important role when in the receiver data terminal uses the data to display the images or replay music. Accordingly, the control portion 33a in the sender node 3a may be configured so that a packet with the marker bit M in the RTP header set is decided to be an important packet.

Description Paragraph (44):
{circle around (2)} Cases Where the Timestamp in the RTP Header is Changed

Description Paragraph (47):
When the payloads of IP packets transmitted from the transmitter data terminal 1 are audio data including talkspurts and silence portions, the size of the packets including the data talkspurts is in general larger than the size of the packet containing the of silence portions. When the packet ~~containing the data of~~ talkspurts is not correctly received in the receiver data terminal 2, the quality of the audio is remarkably deteriorated compared with the case when the packet containing the data of silence portions is not correctly received. Accordingly, when the data in the IP packet transmitted from the transmitter data terminal 1 is audio data, the control portion 33a at the sender node 3a examines whether the payload of each packet is the data of talkspurts or the data of silence portions in accordance with the size of the IP packet, and decides that the packet containing the data of talkspurts, namely the packet having the size larger than the prescribed size, is the important packet.

Description Paragraph (49):
When the payloads of IP packets transmitted from the transmitter data terminal 1 are audio data including talkspurts and silence, the receiver data terminal 2 needs to recognize the switch from talkspurts to silence, and the switch from silence to talkspurts. The control portion 33a at the sender node 3a therefore converts the packet immediately after the switch from silence to talkspurts or the switch from talkspurts to silence into a full-header packet without compressing the header and transmits the full-header packet to the receiver node 3b. Practically, the control portion 33a at the sender node 3a examines whether the size of the IP packet is larger than the prescribed size (constant value) or not whenever receiving the IP packet, and decides that the IP packet received this time is the important packet in the case when the packet received previous time has a smaller size than the prescribed size, and simultaneously the packet received this time has a larger size than the prescribed size. Similarly, the packet received this time is decided to be

the important packet in the case when the packet received previous time has a larger size than the prescribed size, and simultaneously the packet received this time has a smaller size than the prescribed size.

Description Paragraph (52):
b. Generating and Transmitting a Header-compressed Packet and a Full-header Packet

Description Paragraph (53):
The control portion 33a at the sender node 3a outputs the first packet and the IP packet decided to be the important packet within the IP packets received from the transmitter data terminal 1 as a full-header packet to the transmitting portion 32a, while outputting the remaining packets as a header-compressed packet to the transmitting portion 32a.

Description Paragraph (55):
On the other hand, for the IP packet to be transmitted as a header-compressed packet, the control portion 33a produces the compressed header based on the content of the IP packet stored in the storage portion 34a (refer to FIG. 13B)) in the same manner as described in the conventional art, and sends the header-compressed packet containing the compressed header to the transmitting portion 32a.

Description Paragraph (57):
The relay apparatus on the receiver node 3b has the same structure as those of the sender node 3a. More specifically, the relay apparatus on the receiver node 3b includes the receiving portion 31b for receiving the packet from the sender node 3a, the control portion 33b for controlling each portion in the receiver node 3b, the storage portion 34b and a transmitting portion 32b for transmitting the packet outputted from the control portion 33b to the receiver data terminal 2. However, the control portion 33b at the receiver node 3b converts the full-header packet or the header-compressed packet transmitted from the sender node 3a into the IP packet and outputs to the transmitting portion 32b, contrary to the control portion 33a at the sender node 3a described above.

Description Paragraph (59):
Then, the practical operation carried out between the relay apparatuses on the sender node 3a and the receiver node 3b is described with reference to FIG. 3. In FIG. 3, the case is assumed where the video data containing several frames is transmitted from the transmitter data terminal 1. Practically, the packets a1 to a5 are IP packets containing the data of the frame A. The packets b1 to b5 are IP packets containing the data of the frame B. The packets c1 to c5 are IP packets containing the data of the frame C. In addition, for the convenience to explain, as described in {circle around (1)} above, it is assumed hereunder that only the IP packet containing the first data of each frame is decided to be the important packet.

Description Paragraph (61):
Then, when receiving the IP packet a2 from the transmitter data terminal 1, the control portion 33a in the sender node 3a examines whether or not the marker bit M in the RTP header is set. In this case, since the IP packet a2 is not the last packet of the frame A, the marker bit M is not set. Then, the control portion 33a converts the RTP/UDP/IP header in the IP packet a2 into the compressed header based on the content in the full header of the packet a1 retained in the storage portion 34a, and sends the header-compressed packet a2 to the receiver node 3b. Hereafter, the control portion 33a at the sender node 3a conducts the same process in relation to the packets a3 and a4.

Description Paragraph (62):
Then, when receiving the packet a5 from the transmitter data terminal 1, the control portion decides whether the marker bit M in the RTP header is set or not. In this case, since the IP packet a5 is the last packet of the frame A, the marker

bit M is set. Accordingly, the control portion 33a decides that the IP packet received next to the packet a5 is the important packet. As for the IP packet a5, the control portion converts the RTP/UDP/IP header in the IP packet into the compressed header and sends to the receiver node 3b in the same manner as described in relation to the IP packets a2 to a4.

Description Paragraph (63):
Then, the control portion 33a receives the IP packet b1. In this case, since it is clear that the IP packet b1 is the important packet (i.e., the IP packet b1 is the first packet of new frame B) because the maker bit M in the IP packet a5 is set, the control portion 33a converts the RTP/UDP/IP header of the packet b1 into the full header, and writes the content of the full header into the storage portion 34a, and then, sends the full-header packet b1 containing the full header to the receiver node 3b. As for the IP packets b2 to b5 received afterward, the control portion sends them as header-compressed packets to the receiver node 3b in the same manner as described above in relation to the IP packets a2 to a5.

Description Paragraph (65):
Then, the control portion 33b at the receiver node 3b restores the compressed header in the header-compressed packet a2 received through the receiving portion 31b, based on the content of the RTP/UDP/IP header in the IP packet a1 retained in the storage portion 34b, and sends it as the IP packet containing the RTP/UDP/IP header to the receiver data terminal 2. As for the packet a3 received next, the control portion 33b in the receiver node 3b restores the IP packet, and then sends it to the receiver data terminal 2 in the same manner as described above.

Description Paragraph (66):
On the other hand, the example as shown in FIG. 3 exemplifies the case in which the header-compressed packet a4 transmitted from the sender node 3a is lost before reaching the receiver node for some reason. In this case, the receiver node 3b detects that the packet a4 is lost by the fact that the link sequence number in the compressed packet a5 to be received next is not in sequence. Since the header-compressed packet a5 cannot be correctly restored unless the content of the header-compressed packet a4 is referred to, the control portion 33b in the receiver node 3b discards the packet received until the next full-header packet, i.e., the packet a5 is received. On the contrary, the packet b1 containing the first data of the frame B is not discarded like the packet a5 due to the loss of the packet a4, since the packet b1 is sent as the full-header packet.

Description Paragraph (67):
As described above, in the packet transmitting method of the embodiment, the sender node 3a sends the important packet as the full-header packet to the receiver node 3b. Accordingly, even in the case where the packet transmitted from the sender node is lost for some reason, and the header-compressed packet thereafter is discarded due to the loss, the important packet is sent to the receiver data terminal 2 as far as the important packet itself is not lost between the sender node 3a and the receiver node 3b. More specifically, the important packet to display the images (or replay audio) is not discarded at the receiver node 3b due to the lost of the other packets. Therefore, the degree of the influence of the packet loss on the quality of the images at the receiver data terminal can be lowered (for example, the deterioration of the quality of the image displayed or the audio replayed), in comparison with the case in which the full-header packet is sent to the receiver node without considering whether or not the packet is the important packet, as described in the conventional art.

Description Paragraph (68):
In the above, although there is described the case in which the IP packet next to the IP packet with the marker bit in the RTP header set, i.e., the IP packet containing the first data of the frame, is decided to be the important packet, the same operation as described above is applied to the case in which the other IP

packet, namely the IP packets as shown in {circle around (2)} to {circle around (5)} described above are decided to be the important packets.

Description Paragraph (74):
In the case described above in which only the important packet is transmitted as the full-header packet, the intervals to send the full-header packets becomes longer when the number of the important packets to be transmitted is fewer in comparison with the number of the other packets. In this case, it may be considered that a lot of header-compressed packets received until the next full-header packet is received are discarded due to the loss of the header-compressed packet. In order to avoid the above situation, it may be configured so that when the prescribed time T has passed without receiving the important packet after sending the full-header packet F (in other words, without sending the full-header packet), the packet to be transmitted next is sent as the full-header packet F even if the packet is not the important packet, as shown in FIG. 4A. Alternatively, it may be configured so that when a specific number N of header-compressed packets are sent without receiving the important packet after sending the full-header packet F, the packet is sent as the full-header packet F regardless of the importance of the packet to be transmitted next.

Description Paragraph (75):
Furthermore, it can be configured so that the relay apparatus on the sender node converts a non-compressed packet into the full-header packet F and transmits the full-header packet to the receiver node even if the non-compressed packet is not the important packet, every time when a specific number N of packets are transmitted or packets ranging for a specific period of time T are transmitted, as shown in FIG. 4B.

Description Paragraph (82):
a. In the case in which the packet transmission is implemented to send video data obtained by an animated image compression coding algorithm containing an intra-frame coding process and an inter-frames prediction coding process (for example, the animated image coding algorithm corresponding to MPEG (Moving Picture Experts Group)), the IP packet containing the data obtained by the intra-frame coding process (namely, the coded data of the I frame) is assigned to be the important packet. The reason thereof is that unless the I frame is properly restored in the receiver, the following frames with the inter-frames prediction coding implemented with reference to the I frame are not properly restored. b. In the case in which the packet transmission is implemented to send a layered coded data composed of the data of the base layer and the data of the enhanced layer, the IP packet containing the data of the base layer is assigned to be the important packet. The data of the base layer means the data which is highly important to restore the original information when the layered coded data is decoded at the receiver. In addition, the data of the enhanced layer means the data which is not so important as the data of the base layer, but serves to improve the quality of reproduction of the original information when it is properly decoded. For example, in the animated image compression coding algorithm in compliant with MPEG-2, a series of frames to be transmitted are divided into I frame, P frame and B frame. The intra-frame coding is implemented to the I frame. A unidirectional inter-frames prediction is implemented to the P frame with reference to the preceding I frame or P frame. A bidirectional inter-frames prediction coding is implemented to the B frame with reference to the I frame or P frame flowing before and after thereof. In this case, the coded data of the I frame and P frame are the data of the base layer, and the coded data of the B frame is the data of the enhanced layer. The decoder can reproduce the animated image, although a time resolution thereof is low, as far as at least the data of the base layer is correctly received. Thus, the data of the base layer is important so that the data of the base layer is transmitted as the important packet. When the data of the enhanced layer is decoded at the decoder, the B frame is used to compensate the time gap between the I frame and P frame, thus improving the time resolution of the animated image. B. Second Embodiment

Description Paragraph (83):
It is configured in the above first embodiment that the relay apparatus provided on the sender node 3a has a function to convert the IP packet into the header-compressed packet or the full-header packet (hereinafter referred to as a "compression function"), while the relay apparatus provided on the receiver node 3b has a function to convert the header-compressed packet or the full-header packet into the IP packet (hereinafter referred to as a "decompression function"). Contrary to the above, it is configured in the present embodiment that the transmitter data terminal and the receiver node 3b depicted in FIG. 1 have the compression function, while the sender node 3a and the receiver data terminal 2 have the decompression function.

Description Paragraph (84):
Practically, the receiver data terminal 1 produces in sequence the IP packet to be transmitted, and then, decides whether each of the IP packets is the important packet or not in the same manner as the first embodiment. The transmitter data terminal 1 sends the IP packet decided to be the important packet as the full-header packet to the sender node 3a, while the transmitter data terminal 1 sends the remaining packets as the header-compressed packet to the sender node 3a.

Description Paragraph (85):
On the other hand, the relay apparatus provided on the sender node 3a converts the received header-compressed packet or the full-header packet into the IP packet and sends it to the receiver node 3b. Furthermore, the relay apparatus on the receiver node 3b decides whether each of the received IP packets from the sender node 3a is the important packet or not, and sends the IP packet decided to be the important packet as the full-header packet to the receiver data terminal 2, while sending the remaining IP packet as the header-compressed packet to the receiver data terminal 2. The receiver data terminal 2 restores the IP packet on the basis of the received full-header packet or the header-compressed packet from the receiver node 3b, and then displays the images or replays the audio or the like in accordance with the data contained in each of the packets. The same effect as in the first embodiment can be obtained in the above configuration.

Description Paragraph (87):
Also in this embodiment, the transmitter may be configured to consider, as the packet to be transmitted as the full header packet, not only the important packet, but also the IP packet with the static field changed as described in the variation example of the first embodiment (variation example 1), the IP packet to be transmitted after passing a specific period without sending the IP packet or the full-header packet which is intended to be transmitted after transmitting a fixed number of the header-compressed packet without sending the full-header packet (variation example 2), and the IP packet to be transmitted after receiving the CONTEXT_STATE from the sender node 3a.

Description Paragraph (89):
As in the case of the embodiments described above, this embodiment supposes that the packet is transmitted by means of the non-TCP protocol such as UDP. RFC2507 defined the compressed non-TCP header having the format shown in FIG. 5 as the compressed header which can be used for non-TCP packets. There are cases in which the fields for ID of IP and RTP in the header of the non-TCP packet are changed packet by packet. The compressed non-TCP header contains the fields composed of those fields having data which could be changed packet by packet. For convenience, the field thus contained in the compressed non-TCP header will be referred to as a "replace field." ID of IP and RTP shown in FIG. 5 are respectively the replace fields. Each compressed non-TCP header is generated with reference to a full header prior thereto. CID shown in FIG. 5 is the information identifying the full header which is referred to for generating the compressed non-TCP header. The "generation" is the field which is updated when a change is made in the constant fields of the

full header.

Description Paragraph (90):
When receiving a compressed non-TCP header sent from the sender node, the communication apparatus on the receiver node refers to the compressed non-TCP header as well as the full header which is identified by CID contained in the compressed non-TCP header, and generates a header having the replace fields of the compressed non-TCP header and the other fields of the full header. The communication apparatus then uses the generated header for processing the non-TCP packet.

Description Paragraph (92):
The foregoing is the outline of the header compression method for non-TCP packets proposed in RFC2507.

Description Paragraph (93):
The present embodiment is that the present invention is applied to the above-mentioned header compression method for the non-TCP packets. FIGS. 6B and 6C show examples of the packet transmission method of the present embodiment, respectively.

Description Paragraph (94):
In the transmission method as shown in FIG. 6B, when the important packet is transmitted, a refresh-header packet RHP including the compressed non-TCP header instead of the full header is transmitted. The compressed non-TCP header includes all information necessary for recovering from the synchronization loss. Therefore, the same effect as those of the first embodiment is obtained even if the compressed non-TCP header is transmitted instead of the full header.

Description Paragraph (98):
There is another header compression method of the IP packet, ROHC (Robust Header Compression), issued as an Internet-Draft. This embodiment relates to the method of the packet compression and transmission using the ROHC method.

Description Paragraph (99):
In the first to third embodiments already described, the full header containing the content of the original header is transmitted at the time of starting the packet delivery and during the packet delivery, as a refresh header to recover the synchronization at the receiver. In the method of the packet compression and transmission using the ROHC, a refresh header with the format other than the full header is transmitted from the transmitter and the synchronization is recovered at the receiver. Hereunder, the outline of the ROHC is described to help understanding of the technical signification of the present embodiment.

Description Paragraph (100):
FIG. 7 shows a transition of the compression state used in the ROHC. As depicted in the drawing, the ROHC has three kinds of the compression states.

Description Paragraph (101):
When the packet delivery accompanying the header compression is carried out between the sender node and the receiver node, the compression process and reconstructing process are started from the initialization state in the sender node and the receiver node. Furthermore, when the synchronization loss occurs during the packet transmission and reception, the compression process and the reconstruction process have to return to the initialization state, in order to recover the synchronization between the sender node and the receiver node. When a certain condition is satisfied after the compression process and the reconstruction process are initialized, the state of the compression process at the sender node and the state of the reconstruction process at the receiver node are transferred to the difference value changing state which is the further upper state. When a certain

condition is satisfied in this state, the processing states of the compression and reconstruction are transferred to the difference value constant state which is the further upper state. As the processing states of the compression and reconstruction are transitioned to the upper state, the size of the compressed header to be transmitted becomes smaller.

Description Paragraph (103):
The IR header is produced from the IP/UDP/RTP header of the first packet in order to initialize the compression process and the reconstruction process, when the packet delivery using the header compression starts. In FIG. 8A, the Static Chain consists of the information of the Static field which is not changed packet by packet in the IP/UDP/RTP header. The Dynamic chain consists of the information of the Dynamic field which can be changed packet by packet in the IP/UDP/RTP header.

Description Paragraph (104):
The IR-DYN header is produced at the time when the synchronization loss occurs during the packet delivery and the initialization of the reconstructing process of the header is required at the receiver, after the header compression is already started, and sent to the receiver. The IR-DYN header contains only the Dynamic chain, as depicted in FIG. 8B. Since the Dynamic chain includes all the information of the Dynamic field, the synchronization is recovered by the reception thereof at the receiver node.

Description Paragraph (105):
Both the IR header and the IR-DYN header contain CRC computed from the original IP/UDP/RTP header. The node receiving the IR header and the IR-DYN header can examine whether each header is properly restored or not by the use of the CRC.

Description Paragraph (106):
The communication apparatus on the sender node monitors, between the packets, the difference of the Dynamic field of the IP/UDP/RTP header for the packets to be transmitted in order. When there is no change in the difference (namely, difference value constant state), the header-compressed packet containing Type-0 as depicted in FIG. 9A is produced and transmitted to the receiver node. In FIG. 9A, SN represents the sequence number of the RTP. The receiver node learns that there is no change in difference of the Dynamic field between the packets, when receiving the Type-0 header. Then, only the difference available by that time in the Dynamic field is added to the present value thereof to reconstruct the Dynamic field.

Description Paragraph (107):
When the communication apparatus on the sender node recognizes the change in the difference (namely, difference value changing state), the communication apparatus on the sender node produces the header-compressed packet containing Type-1 header or Type-2 header to transfer the new difference to the receiver node, and transmits it to the receiver node. The format of the Type-1 header is depicted in FIG. 9B, and the format of the Type-2 header is depicted in FIG. 9C. In those drawings, SN represents information relating to the difference in RTP sequence number, and TS represents information relating to the difference in RTP timestamp. It is arbitrary that which one of the Type-1 header or the Type-2 header is transmitted.

Description Paragraph (108):
The information relating to the difference mentioned above is obtained by LSB (Least Significant Bit) coding of the corresponding field. FIG. 10 shows the steps of the LSB coding.

Description Paragraph (109):
In this method, when the difference in some field of header between the packets is changed, one or more packets prior to the packet to be compressed are selected as reference packets. It is arbitrary that which packets are selected as the reference packets. The field of header of the packet to be compressed and the corresponding

field of header of the reference packet thus selected are compared with each other, and then the different lower bits are transmitted. In the example depicted in FIG. 10, since the lower four bits are different, the lower four bits are transmitted to the receiver node by the Type-1 header or the Type-2 header. In the receiver node, the lower four bits in the corresponding field of the header of the reference packet are replaced by the data of the lower four bits in the Type-1 header or the Type-2 header, thus the original field can be reconstructed.

Description Paragraph (112):
In the present embodiment, when the important packet is transmitted, the IP/UDP/RTP header of the important packet is converted into either one of the IR header, the IR-DYN header, the Type-1 header or the Type-2 header, and the refresh-header packet containing the header thus converted is transmitted to the receiver node. More detailed description will be given as follows:

Description Paragraph (113):
In the header compressed packet transmission according to ROHC, there are cases in which when the header is received by the communication apparatus on the receiver node and the content of the header is correctly restored, the ACK is transmitted from the receiver node to notify the sender node of the matter. In the present embodiment, when the important packet to be transmitted is generated after receiving such an ACK from the receiver node, the Type-1 header or the Type-2 header is generated from the IP/UDP/RTP header of the important packet with reference to the earlier header which has already been transmitted and acknowledged. The refresh header packet containing the Type-1 or Type-2 header thus generated is then transmitted to the receiver node. The Type-1 or Type-2 header thus transmitted contains the data indicating the difference between the Dynamic field in the IP/UDP/RTP header of the important packet and that of the acknowledged packet for which the ACK has already been received by sender node.

Description Paragraph (115):
There are cases in which when the important packet is transmitted, but there is no header which has already been sent and acknowledged. In such cases, the IR header or the IR-DYN header is generated from the IP/UDP/RTP header of the important packet and the refresh-header packet containing it is transmitted to the receiver node.

Description Paragraph (118):
Each of the above embodiments described above discloses the packet transmitting method applied to the transmission of the IPv4 packet. However, the applicable scope of the present invention is not limited to the above. The present invention can be applied to the transmission of the IPv6 packet. FIG. 12 shows the format of IPv6 header. As shown in the drawing, The IPv6 has the STATIC field which is not changed between the packets, the DYNAMIC fields which may be changed between the packets, and the Eliminated field which has a known value or can be reconstructed from other field. Accordingly, the packet transmitting method described in each of the embodiments or the variations thereof can be applied to the non-compressed packet having the IP/UDP/RTP header in which the IP portion consists of the IPv6 header.

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CLAIMS:

1. A packet transmitting method for transmitting packets from a sender node to a receiver node through a network, comprising the steps of: determining by a communication apparatus provided at the sender node, whether each non-compressed packet to be transmitted is an important packet, on the basis of a header, a timestamp, or size of each non-compressed packet; converting by the communication apparatus provided at the sender node, each non-compressed packet which is determined to be an important packet into a refresh-header packet, the refresh-header packet including a refresh header, the refresh header including enough information to recover synchronization in the receiver node; and transmitting a packet stream containing the refresh-header packet and a header-compressed packet to the receiver node, the header-compressed packet including a compressed header, the compressed header including less information than the refresh header.

2. The packet transmitting method of claim 1, wherein the refresh header is a full header containing a content of an original header included in the non-compressed packet.

4. The packet transmitting method of claim 1, wherein the refresh header is a header produced with reference to a header which has already been transmitted to the receiver node and acknowledged by the receiver node.

5. The packet transmitting method of claim 1, wherein the communication apparatus at the sender node determines whether each one of the non-compressed packets is an important packet, on the basis of a condition of marker bits of real-time transport protocol headers included in the non-compressed packets.

6. The packet transmitting method of claim 5, wherein a non-compressed packet is determined as the important packet when a non-compressed packet transmitted immediately prior to the non-compressed packet has the marker bit set.

7. The packet transmitting method of claim 5, wherein a non-compressed packet is determined as the important packet when the non-compressed packet has the marker bit set.

8. The packet transmitting method of claim 1, wherein the communication apparatus at the sender node determines whether each one of the non-compressed packets to be transmitted is an important packet, on the basis of packet sizes of the non-compressed packets.

9. The packet transmitting method of claim 8, wherein a non-compressed packet is determined as the important packet when the non-compressed packet has a larger size than a predetermined size.

10. The packet transmitting method of claim 8, wherein a non-compressed packet is determined as the important packet when the non-compressed packet has a larger size than a predetermined size and the next non-compressed header has a smaller size than a predetermined size or when the non-compressed packet has a smaller size than the predetermined size and the next non-compressed header has a larger size than the predetermined size.

11. The packet transmitting method of claim 1, wherein a non-compressed packet is determined to be an important packet when the non-compressed packet contains configuration information which is referred to in order to interpret data in the packet in the receiver node.

13. The packet transmitting method of claim 12, wherein a non-compressed packet is

determined as the first packet of the frame when the non-compressed packet contains a timestamp different from a timestamp contained in a preceding non-compressed packet.

14. The packet transmitting method of claim 1, wherein data in each of the packets represents a voice, and a non-compressed packet is determined to be an important packet when the non-compressed packet contains data representing a voice portion.

15. The packet transmitting method of claim 14, wherein the non-compressed packet containing data representing the voice portion is obtained on a basis of a change in packet size of a set of non-compressed packets to be transmitted.

16. The packet transmitting method of claim 1, wherein: data in each of the packets comprises at least a part of coded data representing image for several frames obtained by means of an algorithm containing intra-frame coding process and inter-frames prediction coding process, and a non-compressed packet is determined to be an important packet when the non-compressed packet comprises a packet containing a coded data obtained by the intra-frame coding process.

17. The packet transmitting method of claim 1, wherein: data in each of the packets comprises at least part of a layered coded data consisting of data in a base layer and data in an enhanced layer, and a non-compressed packet is determined to be an important packet when the non-compressed packet comprises a packet containing the data in said base layer.

18. The packet transmitting method of claim 1, wherein the communication apparatus at the sender node converts a non-compressed packet into a full-header packet even if the non-compressed packet is not an important packet, when a prescribed time has passed or a prescribed number of compressed-header packets has been transmitted after transmission of a last full-header packet.

21. The packet transmitting method of claim 1, wherein the communication apparatus at the sender node transmits a non-compressed packet to be transmitted as a refresh-header packet, in response to a request from the receiver node.

22. A program for causing a computer to execute a packet transmitting method for transmitting packets from a sender node to a receiver node through a network, the method comprising the steps of: determining by a communication apparatus provided at the sender node, whether each non-compressed packet to be transmitted is an important packet, on the basis of a header, a timestamp, or size of each of the non-compressed packets; converting by a communication apparatus provided at the sender node, each non-compressed packet which is determined to be an important packet into a refresh-header packet, the refresh-header packet including a refresh header, the refresh header including enough information to recover synchronization in the receiver node; and transmitting a packet stream containing the refresh-header packet and the header-compressed packet to the receiver node, a header-compressed packet including a compressed header, the compressed header including less information than the refresh header.

23. A computer readable storage media for storing a program which makes a computer execute a packet transmitting method for transmitting packets from a sender node to a receiver node through a network, the method comprising the steps of: determining by a communication apparatus provided at the sender node, whether each non-compressed packet to be transmitted is an important packet, on the basis of a header, a timestamp, or size of each of the non-compressed packets; converting by the communication apparatus provided at the sender node, each non-compressed packet which is determined to be an important packet into a refresh-header packet, the refresh-header packet including a refresh header, the refresh header including enough information to recover synchronization in the receiver node; and transmitting a packet stream containing the refresh-header packet and a header-

compressed packet to the receiver node, the header-compressed packet including a compressed header, the compressed header including less information than the refresh header.

24. A relay apparatus provided in a network for receiving packets from a sender node of the network and transmitting the packets to a receiver node of the network, the relay apparatus comprising: a determining unit that determines whether each non-compressed packet to be transmitted is an important packet, on the basis of a header, a timestamp or size of each of the non-compressed packet; a compresser that converts each non-compressed packet which is determined to be an important packet into a refresh-header packet, the refresh-header packet including a refresh header, the refresh header including enough information to recover synchronization in the receiver node; and a transmitter that transmits a packet stream containing the refresh-header packet and a header-compressed packet to the receiver node, the header-compressed packet including a compressed header, the compressed header including less information than the refresh header.

25. A data terminal comprising: a determining unit that determines whether a non-compressed packet to be transmitted is an important packet, on the basis of a header, a timestamp or size of the non-compressed packet; a compresser that converts each non-compressed packet which is determined to be an important packet into a refresh-header packet, the refresh-header packet including a refresh header, the refresh header including enough information to recover synchronization in a receiver node; and a transmitter that transmits a packet stream containing the refresh header packet and the header-compressed packet to the receiver node, a header-compressed packet including a compressed header, the compressed header including less information than the refresh header.

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Wireless real-time IP services enabled by header compre

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Abstract
The world of telecommunications is currently going through a shift of paradigm from circu connection oriented information transfer towards packet switched, connection-less transf independence and to decrease costs for transport and switching it is attractive to go IP a interface to the end user equipment, i.e., to not terminate the IP protocols before the air i reason to avoid using voice over IP over the air interface has, up to now, been the relativ imposed by the IP/UDP/RTP headers of voice packets. This paper presents a novel heac scheme, ROCCO, that can compress the large headers to a minimum of one octet and is errors imposed by cellular links. Its performance is excellent both in terms of robustness efficiency. Moreover, system capacity simulations are presented, which show that ROCC higher system capacity than the other current header compression candidate, CRTP. Fin with ROCCO voice over IP over wireless becomes feasible from a spectrum-efficiency pc

Index Terms
Inspec
Controlled Indexing
cellular radio data compression packet radio networks real-time systems telecommunication services transport protocols

Non-controlled Indexing
CRTP IP protocols IP/UDP/RTP headers ROCCO air interface cellular link compression efficiency end user equipment header compression packet swit connection-less transfer performance robustness spectrum-efficiency syste simulations voice over IP voice packets wireless real-time IP services

Author Keywords
Not Available

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No references available on IEEE Xplore.

Citing Documents

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See application file for complete search history.

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Fleming, K., et al., "Robust Header Compression (ROHC) over Wireless Ethernet Media ROHCoWEM", Oct. 28, 2002, pp. 1-14, INTERNET-DRAFT, (XP-0022465626). cited by other

Le, K., et al., "Efficient and Robust Header Compression for Real-Time Services", Sep. 23, 2000, pp. 924-928, IEEE, vol. 2. cited by other

ART-UNIT: 2667

PRIMARY-EXAMINER: Pham; Chi

ASSISTANT-EXAMINER: Jones; Prenell

ATTY-AGENT-FIRM: Blakely, Sokoloff, Taylor & Zafman LLP

ABSTRACT:

A method and apparatus for increasing the networking capacity of existing wireless networks by using robust header compression. In one embodiment, the method includes initiating a link within a wireless computer network. The method further includes

transmitting data through the link using robust headers. The method may also include negotiating parameters of the link.

5 Claims, 13 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw D

☐ 2. Document ID: US 7103020 B2

L23: Entry 2 of 10 File: USPT Sep 5, 2006

US-PAT-NO: 7103020
DOCUMENT-IDENTIFIER: US 7103020 B2

TITLE: PLMN radio interface with upper layer supervision of layer one transport channels

DATE-ISSUED: September 5, 2006

PRIOR-PUBLICATION:

DOC-ID	DATE
US 20020164980 A1	November 7, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Eriksson; Stefan	Stockholm			SE
Berglund; Arne	Upplands Vasby			SE
Bladsjo; David	Stockholm			SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 10/133199 [PALM]
DATE FILED: April 26, 2002

RELATED-US-APPL-DATA:
us-provisional-application US 60287401 00 20010501

INT-CL-ISSUED:

TYPE	IPC	DATE	IPC-OLD
IPCP	H04Q7/00	20060101	H04Q007/00
IPCS	H04Q7/24	20060101	H04Q007/24

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	H04 Q 7/00	20060101
CIPS	H04 Q 7/24	20060101

US-CL-ISSUED: 370/328; 370/338, 370/469
US-CL-CURRENT: 370/328; 370/338, 370/469

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5636140	June 1997	Lee et al.	370/469
6510137	January 2003	Belaiche	370/232
6539031	March 2003	Ngoc et al.	370/470
6594241	July 2003	Malmlof	370/329
2002/0037000	March 2002	Park et al.	370/349
2002/0085531	July 2002	Herrmann et al.	370/338

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
0938207	August 1999	EP	
1006692	June 2000	EP	
1009174	June 2000	EP	
1047219	October 2000	EP	
1093315	April 2001	EP	
2349042	October 2000	GB	
99/04338	January 1999	WO	
00/62465	October 2000	WO	
01/17283	March 2001	WO	

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Balachandran K., et al.: "A Proposal for EGPRS Radio Link Control Using Link Adaptation and Incremental Redundancy", Bell Labs Technical Journal, Bell Laboratories, US, vol. 4, No. 3, Jul. 1999, pp. 19-36, XP000878195, ISSN: 1089-7089. cited by other
Huard, J-F, et al., "Realizing the MPEG-4 Multimedia Delivery Framework", IEEE Network, IEEE Inc., New York, USA, Nov. 1998, vol. 12, No. 6, pp. 35-45, XP000873126, ISSN: 0890-8044. cited by other
Gessner, C., et al., "Layer 2 and Layer 3 of UTRA-TDD", VTC-2000-Spring, 2000 IEEE 51.sup.st, Vehicular Technology Conference Proceedings, Tokyo, Japan, May 15-18, 2000, IEEE Vehicular Technology Conference, New York, NY:IEEE, US, vol. 2 of 3, Conf. 51, May 15, 2000, pp. 1181-1185, XP000968056, ISBN: 0-7803-5719-1. cited by other
Berg, M., et al., "Performance Enhancements for the GSM/EDGE Radio Access Network", Vehicular Technology Conference Fall 2000, Sep. 24, 2000, vol. 6, pp. 2720-2727, XP010525080, Boston, MA, USA. cited by other
Lau, V. K. N., et al., "Multiple Access Control Protocol for Integrated Isochronous and Bursty Data Services", IEE Proceedings: Communications, Institution of Electrical Engineers, GB, Dec. 11, 2000, vol. 147, No. 6, pp. 311-316, XP006013999. cited by other
Kriaa, F., et al., "Coding of TFCI by Using Channel Optimised B-Adjacent Code for UMTS", ITG Fachberichte, VDE Verlag, Berlin, DE, Jan. 28, 2002, vol. 170, pp. 27-

34, XP001094527, ISSN: 0932-6022. cited by other
"Flexible Layer One for Radio Interface to PLMN", U.S. Appl. No. 10/134,017, filed on Apr. 26, 2002. cited by other
English language abstract of EP Patent 1006692 published Jun. 7, 2000. cit- ed by other
3G TS 25.212 V3.3.0 (Jun. 2000); 3.sup.rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (1999), pp. 8-60. cited by other

ART-UNIT: 2616

PRIMARY-EXAMINER: Nguyen; Chau

ASSISTANT-EXAMINER: Hamann; Jordan

ABSTRACT:

Flexibly configurable layer one transport channels produce radio blocks in response to communication information and extract communication information from radio blocks. One of the transport channels can be enabled to extract its associated communication information from a radio block while another of the transport channels is maintained disabled. The one transport channel provides the extracted communication information to a decision maker in a higher layer. In response to the extracted communication information, the decision maker decides whether the other transport channel should be enabled, and provides to the physical layer an indication of its decision.

29 Claims, 17 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw. D

☐ 3. Document ID: US 7046672 B2

L23: Entry 3 of 10 File: USPT May 16, 2006

US-PAT-NO: 7046672
DOCUMENT-IDENTIFIER: US 7046672 B2

TITLE: Robust, inferentially synchronized transmission of compressed transport-layer-protocol headers

DATE-ISSUED: May 16, 2006

PRIOR-PUBLICATION:

DOC-ID	DATE
US 20020097722 A1	July 25, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liao; HongBin	Tianjin			CN
Zhang; Qian	Hubei			CN
Zhu; Wenwu	Basking Ridge	NJ		US

Zhang; Ya-Qin	West Windsor	NJ	US

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Microsoft Corporation	Redmond	WA		US	02

APPL-NO: 09/848848 [PALM]
DATE FILED: May 3, 2001

RELATED-US-APPL-DATA:
us-provisional-application US 60249712 00 20001116

INT-CL-ISSUED:

TYPE	IPC	DATE	IPC-OLD
IPCP	H04L12/28	20060101	H04L012/28

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	H04 L 12/28	20060101

US-CL-ISSUED: 370/395.1; 370/395.52
US-CL-CURRENT: 370/395.1; 370/395.52

FIELD-OF-CLASSIFICATION-SEARCH: 370/229, 370/235, 370/253, 370/395.1, 370/395.52, 370/389, 370/392, 370/349, 370/393, 370/397, 370/399, 370/471, 370/474, 709/247
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5535199	July 1996	Amri et al.	370/392
5987022	November 1999	Geiger et al.	370/349
6032197	February 2000	Birdwell et al.	709/247
6434168	August 2002	Kari	370/521
6608841	August 2003	Koodli	370/474
6609224	August 2003	Jonsson	714/758
6754231	June 2004	Jonsson et al.	370/474
6804238	October 2004	Euget et al.	370/392

ART-UNIT: 2664

PRIMARY-EXAMINER: Pham; Brenda

ATTY-AGENT-FIRM: Lee & Hayes, PLLC

ABSTRACT:

An implementation of a technology, described herein, for transmitting compressed network transport-layer-protocol headers in a speedy, efficient, inferentially synchronized, and robust manner. An implementation, described herein, models the transmission of compressed headers to the congestion procedure of the network transport-layer protocol (e.g., TCP's). Doing so, the sender of the compressed headers can infer whether the receiver correctly received them. Unlike the slow direct synchronization employed by conventional schemes, this implementation of the present claimed invention inferentially synchronizes by modeling after the congestion procedure of the network transport-layer protocol. This is inherently faster than direct synchronization. Since the implementation performs well over both noiseless and noisy links, it is particularly suited to use over wireless communications channels. This abstract itself is not intended to limit the scope of this patent. The scope of the present invention is pointed out in the appending claims.

23 Claims, 11 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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☐ 4. Document ID: US 6985965 B2

L23: Entry 4 of 10 File: USPT Jan 10, 2006

US-PAT-NO: 6985965
DOCUMENT-IDENTIFIER: US 6985965 B2

TITLE: Static information knowledge used with binary compression methods

DATE-ISSUED: January 10, 2006

PRIOR-PUBLICATION:

DOC-ID	DATE
US 20020059462 A1	May 16, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hannu; Hans	Lulea			SE
Christoffersson; Jan	Lulea			SE
Svanbro; Krister	Lulea			SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 09/814406 [PALM]
DATE FILED: March 21, 2001

RELATED-US-APPL-DATA:
us-provisional-application US 60249642 00 20001116
us-provisional-application US 60249923 00 20001116
us-provisional-application US 60249643 00 20001116

us-provisional-application US 60249497 00 20001116

INT-CL-ISSUED:

TYPE	IPC	DATE	IPC-OLD
IPCP	G06F15/16	20060101	G06F015/16
IPCS	G06F13/12	20060101	G06F013/12

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G06 F 13/12	20060101
CIPP	G06 F 15/16	20060101

US-CL-ISSUED: 709/247; 710/68
US-CL-CURRENT: 709/247; 710/68

FIELD-OF-CLASSIFICATION-SEARCH: 709/247, 709/227, 709/228, 709/230, 341/51, 341/106, 710/68
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5537551	July 1996	Denenberg et al.	709/247
5872530	February 1999	Domyo et al.	341/106
5951623	September 1999	Reynar et al.	341/87
5956490	September 1999	Buchholz et al.	709/245
5973630	October 1999	Heath	341/87
6121901	September 2000	Welch et al.	341/51
6222942	April 2001	Martin	382/232
6256652	July 2001	Saperov et al.	708/203
6345307	February 2002	Booth	709/247
6359548	March 2002	Cooper	341/50
6493766	December 2002	Buchholz et al.	709/247
6553141	April 2003	Huffman	382/232
6751209	June 2004	Hamiti et al.	370/349
6807173	October 2004	Lee et al.	370/389

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
0 666 651	August 1995	EP	
0 933 876	August 1999	EP	
2320657	June 1998	GB	
WO 9839723	September 1998	WO	

OTHER PUBLICATIONS

Deutsch, P. "Deflate Compressed Data Format Specification version 1.3." IETF RFC 1951. (1996). pp. 1-17. cited by other
Bormann C., et al. (2000) Robust Header Compression (ROHC). Internet Draft (work in progress), Oct. 2000, <draft-ietf-rohc-rpt-05.txt> pp. 1-156. cited by other
PCT International Search Report for PCT/SE01/02549; Nov. 15, 2001. cited by other
Stern H P: "Compression Techniques For Mobile Data Terminal Communication", 1991 IEEE 41th Vehicular Technology Conference. St. Louis, May 19-22, 1991, IEEE Vehicular Technology Conference, New York, IEEE, US, vol. Conf. 41, Page(s) 429-432, XP000260216. cited by other
Mitzenmacher M.: "On the Hardness of Finding Optimal Multiple Preset Dictionaries." Proceedings of Data Compression Conference, IEEE 2001, Mar. 27-29, 2001, pp. 411-418, XP002902506. cited by other

ART-UNIT: 2144

PRIMARY-EXAMINER: Thompson; Marc D.

ASSISTANT-EXAMINER: Gerezgiher; Yemane M.

ABSTRACT:

A system, method, and apparatus for increasing the efficiency of the compression of a communication protocol for use over bandwidth limited communication links. One aspect of the present invention uses the knowledge of the structure and content of communication protocols to form a static dictionary or static binary code tree. As a result, the compression efficiency can be greatly increased. Another aspect of the present invention provides a combined static and dynamic dictionary or binary code tree to perform communication protocol compression. In one aspect of the invention, the static binary code tree or static dictionary is constructed by studying flows of data protocols in the conditions of their intended usage.

11 Claims, 5 Drawing figures

☐ 5. Document ID: US 6970476 B1

L23: Entry 5 of 10 File: USPT Nov 29, 2005

US-PAT-NO: 6970476
DOCUMENT-IDENTIFIER: US 6970476 B1

TITLE: Efficient header compression context update in packet communications

DATE-ISSUED: November 29, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Jonsson; Lars-Erik	Lulea			SE
Hannu; Hans	Lulea			SE
Svanbro; Krister	Lulea			SE

Haraszti; Zolt	Kista	SE
Furuskar; Anders	Stockholm	SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 09/671371 [PALM]
DATE FILED: September 26, 2000

PARENT-CASE:
This application claims the benefit of provisional application Ser. No. 60/188,284 filed Mar. 7, 2000.

INT-CL-ISSUED: [07] H04L 12/28

US-CL-ISSUED: 370/401; 370/465, 370/477
US-CL-CURRENT: 370/401; 370/465, 370/477

FIELD-OF-CLASSIFICATION-SEARCH: 370/252, 370/349, 370/401, 370/402, 370/394, 370/410, 370/522-524, 370/474, 370/477, 370/392, 370/465
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5245616	September 1993	Olson	371/32
5799013	August 1998	Seshadri et al.	370/342
5987022	November 1999	Geiger et al.	370/349
6198735	March 2001	Pazhyannur et al.	370/349
6542931	April 2003	Le et al.	709/228
6608841	August 2003	Koodli	370/474

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
WO 99/17489	April 1999	WO	

OTHER PUBLICATIONS

Khiem et al.; Efficient and Robust Header Compression For Real-Time Services; Nokia Research Center; Wireless Communications and Networking Con 2000; WCNC IEEE; Sep. 23-28, 2000; pp. 924-928.
PCT Search Report; PCT/SE 01/00440; Mailed Jul. 12, 2001.

ART-UNIT: 2665

PRIMARY-EXAMINER: Hsu; Alpus H.

ASSISTANT-EXAMINER: Ryman; Daniel

ABSTRACT:

In packet communications that utilize header compression/decompression, relatively fast and reliable header compression context updates can be accomplished with relatively low overhead by: sending anticipatory context update requests before decompressor context invalidation is detected; sending redundant context update requests; and sending redundant context updates. Transmission parameters associated with both context update requests and context updates can be controlled appropriately to improve their chances for delivery, and needless context update requests can be identified and ignored at the header compression side.

18 Claims, 12 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw D

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6. Document ID: US 6963587 B2

L23: Entry 6 of 10 File: USPT Nov 8, 2005

US-PAT-NO: 6963587
DOCUMENT-IDENTIFIER: US 6963587 B2

TITLE: Communication system and method utilizing request-reply communication patterns for data compression

DATE-ISSUED: November 8, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hannu; Hans	Lulea			SE
Christoffersson; Jan	Lulea			SE
Svanbro; Krister	Lulea			SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 09/814407 [PALM]
DATE FILED: March 21, 2001

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATIONS This patent application is related to and claims priority from U.S. patent application Ser. No. 60/249,642, filed Nov. 16, 2000; U.S. patent application Ser. No. 09/814,406 filed concurrently herewith, entitled "Static Information Knowledge Used With Binary Compression Method"; U.S. patent application Ser. No. 09/814,268 filed concurrently herewith, entitled "System and Method For Communicating With Temporary Compression Tables"; and U.S. patent application Ser. No. 09/814,434 filed concurrently herewith, entitled "Communication System and Method For Shared Contest Compression".

INT-CL-ISSUED: [07] H04J 3/18

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	H04 L 29/06	20060101
CIPS	H03 M 7/30	20060101
CIPS	H04 L 1/16	20060101

US-CL-ISSUED: 370/477; 709/247
US-CL-CURRENT: 370/477; 709/247

FIELD-OF-CLASSIFICATION-SEARCH: 370/477, 370/238, 370/310, 370/474, 370/389-395, 370/516, 370/521, 709/247, 709/200-211, 341/106, 341/51, 341/60-65, 341/87, 375/240, 455/72
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5293379	March 1994	Carr	370/474
5537551	July 1996	Denenberg et al.	709/247
5841971	November 1998	Longginou et al.	709/200
6067381	May 2000	Benayoun et al.	382/232
6192259	February 2001	Hayashi	455/575.1
6222942	April 2001	Martin	382/232
6246672	June 2001	Lumelsky	370/310
6345307	February 2002	Booth	709/247
6680955	January 2004	Le	455/575.1
6711164	March 2004	Le et al.	370/392

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
9224018	August 1997	JP	
WO 01/56169	August 2001	WO	

OTHER PUBLICATIONS

Luiz M. Alves Dos Dantos, Multimedia Data and Tools for Web Services over Wireless Platforms, Oct. 1998, IEEE Personal Communciation, vol. 5, No. 5, pp. 42-46.
"The Prevention of Error Propagation in Dictionary Compressionwith Update and Deletion" by James A. Storer form the Data Compression Conference in 1998, pp. 199-208.
Deutsch, P. "Deflate Compressed Data Format Specification version 1.3."IETF RFC 1951. (1996). Pp. 1-17.
Bormann C., et al. (2000) Robust Header Compression (ROHC). Internet Draft (work in progress), Oct. 2000, .degree.draft-ietf-rohc-rpt-05.txt< Pp. 1-156.

ART-UNIT: 2667

PRIMARY-EXAMINER: Pham; Chi

ASSISTANT-EXAMINER: Jones; Prenell

ABSTRACT:

A method, system, and apparatus for increasing the efficiency and robustness of the compression of a communication protocol for communication between entities over bandwidth limited communication links. The present invention uses the request-reply nature of communication protocols to update compression and decompression dictionaries. Each communication entity will update its dictionary with a new message as soon as it is known that the other communication entity has access to the message. In one aspect of the present invention, an entity updates a compression/decompression dictionary by updating the dictionary with sent messages as soon as a reply arrives from the other entity, and by updating the dictionary with received messages immediately. In another aspect of the present invention, received messages are used to update an entity's decompression dictionary and sent messages are used to update an entity's compression dictionary.

13 Claims, 5 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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7. Document ID: US 6950445 B2

L23: Entry 7 of 10 File: USPT Sep 27, 2005

US-PAT-NO: 6950445
DOCUMENT-IDENTIFIER: US 6950445 B2

TITLE: Communication system and method for shared context compression

DATE-ISSUED: September 27, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Svanbro; Krister	Lulea			SE
Allden; Johan	Lulea			SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 09/814434 [PALM]
DATE FILED: March 21, 2001

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATIONS This patent application is related to and claims priority from U.S. Patent Application No. 60/249,497, filed Nov. 16, 2000 U.S. patent application Ser. No. 09/814,406, filed concurrently herewith, entitled

"Statio Information Knowledge Used With Binary Compression Method" U.S. patent application Ser. No. 09/814,407, filed concurrently herewith, entitled "Communication System and Method Utilizing Request-Repy Communication Patterns For Data Compression" and U.S. patent application Ser. No. 09/814,268, filed concurrently herewith, entitled "System and Method For Communication With Temporary Compression Tables".

INT-CL-ISSUED: [07] H04J 3/18

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	H03 M 7/30	20060101

US-CL-ISSUED: 370/477; 709/247
US-CL-CURRENT: 370/477; 709/247

FIELD-OF-CLASSIFICATION-SEARCH: 370/477, 370/474, 370/238, 370/310, 370/516, 370/521, 709/247, 709/200-211, 341/106, 341/51, 341/60-65, 341/87
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5258983	November 1993	Lane et al.	370/477
5293379	March 1994	Carr	370/474
5384780	January 1995	Lomp et al.	370/238
5410671	April 1995	Elgamal et al.	711/202
5537551	July 1996	Denenberg et al.	709/247
5689589	November 1997	Gormish et al.	382/239
5841971	November 1998	Longginou et al.	709/200
6032197	February 2000	Birdwell et al.	709/247
6041054	March 2000	Westberg	370/389
6222942	April 2001	Martin	382/232
6246672	June 2001	Lumelsky	370/310
6300887	October 2001	Le	341/60
6345307	February 2002	Booth	709/247
6680955	January 2004	Le	370/477

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
WO 00/38098	June 2000	WO	

OTHER PUBLICATIONS

Luiz M. Alves Dos Santos, Multimedia Data and Tools for Web Services over Wireless Platforms, Oct. 1998, IEEE Personal Communication, vol. 5, No. 5, pp. 42-46.

Alves dos Santos, "Multimedia Data and Tools for Web Services Over Wireless Platforms", IEEE Personal Communications, vol. 5, No. 5, Oct. 1, 1998, pp. 42-46.
PCT International Search Report for PCT/SE01/02551, Aug. 26, 2002.
Deutsch, P. "Deflate Compressed Data Format Specification version 1.3." IETF RFC 1951. (1996). pp. 1-17.
Bormann C., et al. (2000) Robust Header Compression (ROHC). Internet Draft (work in progress), Oct. 2000, <draft-ietf-rohc-rpt-05.txt> pp. 1-156.

ART-UNIT: 2667

PRIMARY-EXAMINER: Pham; Chi

ASSISTANT-EXAMINER: Jones; Prenell

ABSTRACT:

A system, method, and apparatus for increasing the efficiency of the compression of a communication protocol for use over bandwidth limited communication links. One aspect of the present invention provides for the sharing of context information between a compressor and decompressor at each communication entity in a communication system. As a result, context information will be shared for each channel pair. In another aspect of the present invention, multiple communication sessions between communication entities may share the same context information for the compression and decompression of communication messages.

27 Claims, 4 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw De

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8. Document ID: US 6909702 B2

L23: Entry 8 of 10 File: USPT Jun 21, 2005

US-PAT-NO: 6909702
DOCUMENT-IDENTIFIER: US 6909702 B2

TITLE: Method and apparatus for out-of-band transmission of broadcast service option in a wireless communication system

DATE-ISSUED: June 21, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Leung; Nikolai K. N.	Takoma Park	MD		
Hsu; Raymond T.	San Diego	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
QUALCOMM, Incorporated	San Diego	CA			02

APPL-NO: 09/934021 [PALM]
DATE FILED: August 20, 2001

PARENT-CASE:
CLAIM OF PRIORITY UNDER 35 U.S.C. .sctn.120 The present Application for Patent claims priority of U.S. Provisional Application No. 60/279,970, filed Mar. 28, 2001, assigned to the assignee hereof and hereby expressly incorporated by reference herein. REFERENCE TO CO-PENDING APPLICATIONS FOR PATENT The present invention is related to the following Applications for Patent in the U.S. Patent & Trademark Office: "Method and Apparatus for Security in a Data Processing System" by Philip Hawkes et al., having Ser. No. 09/933,972, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein; "Method and Apparatus for Overhead Messaging in a Wireless Communication System" by Nikolai Leung, having Ser. No. 09/933,971, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein; "Method and Apparatus for Broadcast Signaling in a Wireless Communication System" by Nikolai Leung, having Ser. No. 09/817,763, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein; "Method and Apparatus for Transmission Framing in a Wireless Communication System" by Raymond Hsu, having Ser. No. 09/933,639, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein; "Method and Apparatus for Data Transport in a Wireless Communication System" by Raymond Hsu, having Ser. No. 09/933,977, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein; and "Method and Apparatus for Header Compression in a Wireless Communication System" by Raymond Hsu, having Ser. No. 09/933,690, filed concurrently herewith and assigned to the assignee hereof, and which is expressly incorporated by reference herein.

INT-CL-ISSUED: [07] H04B 7/005

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPN	H04 L 29/08	20060101
CIPS	H04 L 29/06	20060101
CIPN	H04 L 9/28	20060101
CIPS	H04 L 12/56	20060101
CIPN	H04 L 9/30	20060101
CIPS	H04 L 9/08	20060101
CIPS	H04 L 12/18	20060101
CIPS	H04 Q 7/38	20060101

US-CL-ISSUED: 370/278; 370/252, 709/220
US-CL-CURRENT: 370/278; 370/252, 709/220

FIELD-OF-CLASSIFICATION-SEARCH: 370/338, 370/278, 370/252, 370/329, 370/310, 370/311, 370/342, 370/389, 370/390, 370/395.1, 370/464, 370/469, 370/473-475, 370/479, 370/312, 709/225, 709/220, 455/412.1, 375/240, 375/240.01
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5101501	March 1992	Gilhousen et al.	

5353332	October 1994	Raith et al.	455/455
5448568	September 1995	Delpuch et al.	370/473
5473609	December 1995	Chaney	370/312
5768276	June 1998	Diachina et al.	370/432
5990928	November 1999	Sklar et al.	370/312
6032197	February 2000	Birdwell et al.	709/247
6081907	June 2000	Witty et al.	714/6
6108706	August 2000	Birdwell et al.	709/229
6510515	January 2003	Raith	
6614804	September 2003	McFadden et al.	370/468
6665718	December 2003	Chuah et al.	709/225

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
1024661	August 2000	EP	
0079734	December 2000	WO	

ART-UNIT: 2662

PRIMARY-EXAMINER: Pezzlo; John

ATTY-AGENT-FIRM: Wadsworth; Philip R. Nguyen; Thien T.

ABSTRACT:

Method and apparatus for providing an overhead information for a broadcast service in a wireless communication system via an out-of-band transmission. The mobile station is able to contact the content server directly using the out-of-band signaling over a packet data service option. The out-of-band communication allows the content server to update the information without transmitting via an intermediate infrastructure element. In one embodiment, the overhead information includes a service option number corresponding to a set of broadcast parameters, such as those identifying a protocol stack for processing broadcast content.

17 Claims, 24 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KWIC	Draw. D

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9. Document ID: US 6883035 B2

L23: Entry 9 of 10 File: USPT Apr 19, 2005

US-PAT-NO: 6883035
DOCUMENT-IDENTIFIER: US 6883035 B2

TITLE: System and method for communicating with temporary compression tables

DATE-ISSUED: April 19, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hannu; Hans	Lulea			SE
Christoffersson; Jan	Lulea			SE

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Telefonaktiebolaget LM Ericsson (publ)	Stockholm			SE	03

APPL-NO: 09/814268 [PALM]
DATE FILED: March 21, 2001

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATIONS This patent application is related to and claims priority from U.S. Patent Application No. 60/249,643, filed Nov. 16, 2000; U.S. patent application Ser. No. 09/814,406, filed concurrently herewith, entitled "Static Information Knowledge Used With Binary Compression Method"; U.S. patent application Ser. No. 09/814,407, filed concurrently herewith, entitled "Communication System and Method Utilizing Request-Reply Communication Patterns For Data Compression"; and and U.S. patent application Ser. No. 09/814,434, filed concurrently herewith, entitled "Communication System and Method For Shared Context Compression".

INT-CL-ISSUED: [07] G06F 13/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	H04 B 1/66	20060101
CIPS	H03 M 7/30	20060101
CIPS	H04 L 29/06	20060101
CIPN	H04 Q 7/22	20060101

US-CL-ISSUED: 709/247; 709/217, 709/238, 709/250
US-CL-CURRENT: 709/247; 709/217, 709/238, 709/250

FIELD-OF-CLASSIFICATION-SEARCH: 709/217, 709/238, 709/247, 709/250, 709/203, 709/219, 709/237, 709/246
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5293379	March 1994	Carr	370/474
5530645	June 1996	Chu	364/419.13
5537551	July 1996	Denenberg et al.	709/247
5889818	March 1999	Spiess	375/240
6067381	May 2000	Benayoun et al.	382/232

6082776	July 2000	Feinberg	283/72
6145069	November 2000	Dye	711/170
6222942	April 2001	Martin	382/232

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
0 788 239	August 1997	EP	

OTHER PUBLICATIONS

Hans Hannu, et al.; "Robust Generic Message Size Reduction (ROGER)"; Network Working Troup, Internet-Draft; Feb. 23, 2001.
PCT; International Serach Report for PCT/SE01/02341; May 2, 2002.
Deutsch, P. "Deflate Compressed Data Format Specification version 1.3." IETF RFC 1951. (1996). pp. 1-17.
Bormann C., et al. (2000) Robust Header Compression (ROHC). Internet Draft (work in Progress), Oct. 2000, <draft-ietf-rohc-rpt-05.txt>pp. 1-156.

ART-UNIT: 2154

PRIMARY-EXAMINER: Vu; Viet D.

ABSTRACT:

A method, system, and apparatus for increasing the efficiency and robustness of the compression of messages using a communication protocol for communication between entities over bandwidth-limited communication links. In one aspect of the present invention, a dictionary compression method is used to compress and decompress messages between communication entities. Each communication entity includes a static dictionary, a dynamic dictionary, a Temporary Receiver Dictionary, and a Temporary Sender Table. During compression of messages, a compressor in each entity uses the static dictionary, the dynamic dictionary, and the Temporary Receiver Dictionary as compression dictionaries. During decompression of messages, a decompressor in each entity uses the static dictionary, the dynamic dictionary, and the Temporary Sender Table as decompression dictionaries.

11 Claims, 5 Drawing figures

☐ 10. Document ID: US 6882637 B1

L23: Entry 10 of 10 File: USPT Apr 19, 2005

US-PAT-NO: 6882637
DOCUMENT-IDENTIFIER: US 6882637 B1

TITLE: Method and system for transmitting and receiving packets

DATE-ISSUED: April 19, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Le; Khiem	Coppell	TX		
Clanton; Christopher Lamonte	Richardson	TX		
Zheng; Haihong	Coppell	TX		
Liu; Zhigang	Irving	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Nokia Networks Oy	Espoo			FI	03

APPL-NO: 09/536639 [PALM]
DATE FILED: March 28, 2000

PARENT-CASE:
CROSS REFERENCE TO RELATED APPLICATIONS This application claims the filing date of U.S. provisional application Ser. No. 60/159,360, filed Oct. 14, 1999, entitled "Method and System for Transmitting and Receiving Data Packets". Reference is also made to U.S. patent application Ser. No. 09/522,497, entitled "An Efficient Handoff Procedure for Header Compression", filed on Mar. 9, 2000, which application is incorporated herein by reference in its entirety. Reference is also made to U.S. patent application Ser. No. 09/536,618, entitled "Variable Length Encoding of Compressed Data", filed on even date herewith, which application is incorporated herein by reference in its entirety.

INT-CL-ISSUED: [07] H04J 3/06, H03M 7/00, G06F 15/16

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	H04 L 1/18	20060101
CIPS	H04 L 29/06	20060101
CIPS	H04 L 1/16	20060101

US-CL-ISSUED: 370/349; 370/350, 370/474, 341/60, 375/240.07, 375/240.28, 709/247
US-CL-CURRENT: 370/349; 341/60, 370/350, 370/474, 375/240.07, 375/240.28, 709/247

FIELD-OF-CLASSIFICATION-SEARCH: 370/349, 370/350, 370/389, 370/392, 370/394, 370/395.1, 370/396.6, 370/395.61, 370/465, 370/470, 370/471, 370/474, 370/521, 341/51, 341/60, 348/461, 348/464, 348/465, 348/467, 348/469, 375/240, 375/240.02, 375/240.07, 375/240.25, 375/240.26, 375/240.28, 709/236, 709/246, 709/247, 714/748, 714/749, 714/750, 714/775, 714/776, 725/87, 725/91, 725/93, 725/94, 725/95, 725/98
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4617657	October 1986	Drynan et al.	370/60
5293379	March 1994	Carr	370/474
5446736	August 1995	Gleeson et al.	370/473

5579316	November 1996	Venters et al.	370/392
5627829	May 1997	Gleeson et al.	370/230
5835730	November 1998	Grossman et al.	709/247
6032197	February 2000	Birdwell et al.	709/247
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6198735	March 2001	Pazhyannur et al.	370/349
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6304914	October 2001	Deo et al.	709/247
6542931	April 2003	Le et al.	709/228

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FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
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0933949	August 1999	EP	
1056259	November 2000	EP	
57184349	November 1982	JP	
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0079764	December 2000	WO	

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Mathur S; Lewis M: "Compressing IPX Headers Over WAN Media (CIPX)" IETF: Request for Comments 1553, Dec. 31, 1993, pp. 1-23, XP002162392.
Casner & Jacobson et al: "Compressing IP/UDP/RTP Headers for Low-Speed Serial Links" IETF: Request for Comments 2508, pp. 1-24, Aug. 1999, XP002133454.
Degermark M et al: "Low-Loss TCP/IP Header Compression for Wireless Networks", Wireless Networks, ACM, US, vol. 3, No. 5, Oct. 1, 1997, pp. 375-387, XP000728935 ISSN: 1022-0038.
Degermark M: "RFC2507: IP Header Compression", IP Header Compression, Network Working Group, XX, XX, Mar. 1, 1999, pp. 1-47, XP002157130.

ART-UNIT: 2665

PRIMARY-EXAMINER: Hsu; Alpus H.

ATTY-AGENT-FIRM: Antonelli, Terry, Stout & Kraus, LLP

ABSTRACT:

The invention is a system and method for synchronizing the transmission of compressed headers in data packets between a transmitter and a receiver having a preferred wireless application which is an improvement of RFC2508. In a system having a transmitter transmitting a plurality of packets each containing a header to a receiver, a method of synchronizing the transmission of compressed headers between the transmitter and receiver in accordance with the invention includes transmitting a current packet from the transmitter to the receiver containing information that the transmitter is prepared to send subsequently transmitted packets in which the headers therein are to be compressed in comparison to the header contained in the current packet; and transmitting from the receiver to the transmitter an acknowledgment packet that the receiver has received the current packet.

97 Claims, 26 Drawing figures

Full | Title | Citation | Front | Review | Classification | Date | Reference | | | Claims | KWIC | Draw D

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Term	Documents
COMPAR$	0
COMPAR	3928
COMPARA	4399
COMPARAAM	1
COMPARAAMPLE	1
COMPARAAND	1
COMPARAASTRINGENT	1
COMPARAATIVE	3
COMPARAATOR	5
COMPARAB	1
COMPARABALE	5
(L22 AND COMPAR$).USPT.	10

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